

2015 NSEI (Northern Southeast Inside Subdistrict) Sablefish Mark-Tag Survey

by

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and

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Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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Weights and measures (metric)		General		Mathematics, statistics	
centimeter	cm	Alaska Administrative Code		all standard mathematical signs, symbols and abbreviations	
deciliter	dL		AAC		
gram	g	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	H _A
hectare	ha			base of natural logarithm	<i>e</i>
kilogram	kg	all commonly accepted		catch per unit effort	CPUE
kilometer	km	professional titles	e.g., Dr., Ph.D., R.N., etc.	coefficient of variation	CV
liter	L			common test statistics	(F, t, χ^2 , etc.)
meter	m	at	@	confidence interval	CI
milliliter	mL	compass directions:		correlation coefficient (multiple)	R
millimeter	mm	east	E	correlation coefficient (simple)	r
Weights and measures (English)		north	N	covariance	cov
cubic feet per second	ft ³ /s	south	S	degree (angular)	°
foot	ft	west	W	degrees of freedom	df
gallon	gal	copyright	©	expected value	<i>E</i>
inch	in	corporate suffixes:		greater than	>
mile	mi	Company	Co.	greater than or equal to	≥
nautical mile	nmi	Corporation	Corp.	harvest per unit effort	HPUE
ounce	oz	Incorporated	Inc.	less than	<
pound	lb	Limited	Ltd.	less than or equal to	≤
quart	qt	District of Columbia	D.C.	logarithm (natural)	ln
yard	yd	et alii (and others)	et al.	logarithm (base 10)	log
Time and temperature		et cetera (and so forth)	etc.	logarithm (specify base)	log ₂ , etc.
day	d	exempli gratia (for example)	e.g.	minute (angular)	'
degrees Celsius	°C	Federal Information Code	FIC	not significant	NS
degrees Fahrenheit	°F	id est (that is)	i.e.	null hypothesis	H ₀
degrees kelvin	K	latitude or longitude	lat or long	percent	%
hour	h	monetary symbols (U.S.)	\$, ¢	probability	P
minute	min	months (tables and figures): first three letters	Jan.,...,Dec	probability of a type I error (rejection of the null hypothesis when true)	α
second	s	registered trademark	®	probability of a type II error (acceptance of the null hypothesis when false)	β
Physics and chemistry		trademark	™	second (angular)	"
all atomic symbols		United States (adjective)	U.S.	standard deviation	SD
alternating current	AC	United States of America (noun)	USA	standard error	SE
ampere	A	U.S.C.	United States Code	variance	
calorie	cal			population sample	Var var
direct current	DC	U.S. state	use two-letter abbreviations (e.g., AK, WA)		
hertz	Hz				
horsepower	hp				
hydrogen ion activity (negative log of)	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

FISHERY DATA SERIES NO. 17-24

**2015 NSEI (NORTHERN SOUTHEAST INSIDE SUBDISTRICT)
SABLEFISH MARK-TAG SURVEY**

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ABSTRACT

The Alaska Department of Fish and Game (ADF&G) manages the Northern Southeast Inside (NSEI) Subdistrict sablefish (*Anoplopoma fimbria*) fishery in Southeast Alaska. Mark-recapture methods have been used to estimate abundance of this stock since 1997. In 2015, longlined pot gear was used to catch sablefish in the NSEI management area, which includes the waters of Chatham Strait and Frederick Sound. Thirty-three sets (1,317 pots) were hauled, capturing 8,613 sablefish. Sablefish were sampled for length, health condition, and tag number, for fish that were previously tagged. Healthy sablefish (that were not previously tagged) with fork lengths between 430–1120 mm were finclipped, tagged, and released. A total of 6,862 sablefish were marked and released in statistical areas within depth zones proportional to the average 2012–2014 commercial sablefish harvest. In addition, temperature measurements were collected to monitor the temperatures that sablefish were exposed to during capture and handling.

Key words: Sablefish, black cod, *Anoplopoma fimbria*, Southeast Alaska, Northern Southeast Inside, NSEI, Chatham Strait, Frederick Sound, tagging, marking, mark-recapture

INTRODUCTION

Sablefish (*Anoplopoma fimbria*) are one of the most commercially valuable species in Southeast Alaska. The Northern Southeast Inside Subdistrict (NSEI) longline fishery that occurs in the deep waters (665 to 891 fathoms) of Chatham Strait (between 58°19'N and 56°10'N latitude) and Frederick Sound (approximately 134°25'W, 56°51'N to 133°54'W, 57°22'N; Figure 1) had an exvessel value of \$3.4 million in 2015 with an average price paid of \$4.35 per round pound¹. Sablefish are a long-lived species with a maximum reported age of 91 years in Southeast Alaska, with the majority of fish harvested in NSEI being under 20 years. Strategic management of this highly valued resource is necessary to ensure the long-term sustainability of this important fishery.

The Alaska Department of Fish and Game (ADF&G) obtains abundance estimates for sablefish in NSEI using mark-recapture methods. The marking survey has occurred since 1997 using external T-bar tags, with the exception of 2004 when Passive Integrated Transponder (PIT) tags were used. Additionally, the upper or lower caudal fin has been clipped to mark fish, with the exception of 1999 when only tagging was performed. From 1997 to 1999, sablefish were marked during the annual longline survey; catch per unit effort (CPUE) and biological data were also collected during this survey. Fishery recapture data indicated that fish were hook-shy (i.e., they avoided recapture by longline) due to their initial capture by longline gear for marking (Carlile et al. 2002). As a result, the mark-recapture study was not performed in 1999, but it was reinstated the following year using longlined pots to avoid hook-shyness. The longline survey continues to occur annually; however, only CPUE and biological data are collected. In 2011, the marking survey was cancelled due to mechanical problems with the contract vessel, and the survey was transitioned to an ADF&G vessel (R/V *Medeia*) in 2012. Due to funding the marking survey has been conducted in odd years starting in 2013.

ADF&G uses the abundance estimate derived from the mark-tag survey and other fishery and biological data to set the annual NSEI sablefish annual harvest objective (AHO). The mark-tag survey goal is to mark sablefish among statistical areas in proportion to sablefish population abundance; commercial fishery harvest data are used to calculate marking goals based on the assumption that population abundance is proportional to commercial harvest (Dressel 2009). Prior to the 2009 survey, sablefish were marked in proportion to the depth and statistical area

¹ Metric units were not used here because the standard units recorded for processing sablefish are round pounds.

where fish were commercially harvested during the preceding year only. Beginning in 2009, sablefish were marked in proportion to the average commercial harvest and depth by statistical area for the previous three years to better approximate the average catch patterns of the upcoming fishery.

The sablefish mark-tag survey has occurred annually in May/June, ending approximately a month and a half before the NSEI commercial longline fishery begins (August 15). This time frame allows adequate mixing of marked and unmarked fish while minimizing fish movement in and out of NSEI before the recapture phase of the study. For mark recovery, dockside samplers observe the majority of the NSEI commercial sablefish landings occurring in Sitka, Juneau, and Petersburg. Fish are carefully examined for tail clips, and the total number of fish with and without tail clips is used to determine abundance using Chapman's modification of the Peterson estimator (Chapman 1951). Tags are typically removed at sea by vessel crew and attached to a logbook. Tags missed by vessel crew are recovered by processor staff and given to ADF&G personnel. As an incentive for fishermen and processor staff to return tags, ADF&G offers a reward for each tag recovered, such as a baseball cap or t-shirt. In addition, fishermen who provide catch location (latitude and longitude) and catch date for tags they return are entered into a lottery for monetary rewards.

This report summarizes the marking and tagging activities from the 2015 NSEI sablefish mark-tag survey. The results for the 2015 mark-recapture study, including the population abundance estimate, will not be presented in this report.

OBJECTIVES

1. Capture, tag, finclip, and release 7,000 sablefish greater than 320 mm fork length in order to estimate population abundance based on a mark-recapture estimate.
2. Mark sablefish among statistical areas in proportion to the average of the 2012–2014 NSEI commercial harvest by statistical area.
3. Mark and tag sablefish evenly within each statistical area and by depth in proportion to the 2012–2014 NSEI commercial harvest.
4. Record temperatures to which sablefish are exposed during capture and handling.

METHODS

OPERATIONS

The survey was conducted in statistical areas where at least 2% of the average NSEI sablefish commercial fishery harvest occurred during the 2012–2014 fishing seasons (Table 1). The ADF&G research vessel, R/V *Medeia*, was used to conduct the 2015 sablefish mark-tag survey. Vessel crew and scientific staff are listed in Appendix A.

Sablefish were captured in longline pot sets. Each longline set consisted of 39 to 40 pots with approximately 91 m of line between each pot. On each end of the line, several buoys and 5.5 m “high flyers” were attached. High flyers are floating flagpoles designed to be visible several meters above the water line under high tide conditions when the buoys may be submerged. Pots were conical, weighed 36 kg, and had a 1.5 m bottom diameter, 1.1 m total vertical height, and 0.65 m top diameter. Each pot had two opposing tunnels for sablefish to enter.

In general, two pot strings were set and hauled per day. Approximately of 4 kg of chopped bait, consisting of 50% squid and 50% pollock, was placed in a bait bag and clipped inside each pot. Soak time was adjusted dependent on the vessel's operating schedule, distance between sets, weather, and the history of sand flea (Amphipoda: Uristidae) abundance; in locations with a history of high sand flea abundance, soak time was minimized to prevent sablefish mortalities. In addition, pots were soaked for a minimum of 9 hours to allow sufficient time for bait scent to disperse and sablefish to travel to baited pots. Contents of each pot were released onto a sorting table and non-sablefish catch was recorded and released overboard, and sablefish were funneled into a live well prior to sampling.

DATA COLLECTION

The data collected on the mark-tag survey are stored in the Alexander Integrated Fisheries Database (IFDB).

All sablefish were measured to the nearest 10 mm fork length. Individually numbered external T-bar tags were inserted into the flesh on the left side of the fish under the first dorsal fin if the fish was healthy and in good condition. Tagged fish were also marked with a finclip on the lower lobe of their caudal fin and sampled for length (Figure 2).

Fish were not tagged or finclipped if they were determined to have reduced survivability due to flea bites, injuries, or a lack of vigor. Fish that were ≤ 320 mm fork length were not tagged or finclipped because fish this size are typically not retained in the commercial fishery.

Captured fish that were previously tagged with an ADF&G tag and were in good health were released after recording the tag number and fork length (to the nearest 10 mm). Fish that were previously tagged by the National Marine Fisheries Service Auke Bay Laboratory and Canada's Department of Fisheries and Oceans were retained or released according to agency instructions. Fish and invertebrates incidentally captured were identified prior to release, with most fish and crabs enumerated as well. Pacific halibut (*Hippoglossus stenolepis*) were enumerated, and their condition (live vs. dead) prior to release was also recorded.

Delayed mortality or immunological suppression has been observed in experiments where capture of sablefish was simulated with gear (hook or trawl) contact and elevated air and/or water temperature exposure of 15 minutes or more (Davis et al. 2001; Davis 2005; Lupes et al. 2006). Temperature data recorded to the nearest 0.02°C^2 were collected during sablefish capture and handling to determine whether any elevated temperatures or extreme temperature differences between bottom, surface, and holding tanks occurred during the survey that could contribute to sablefish mortality. Temperatures to which sablefish were exposed during capture and handling, including sea surface, ocean bottom, and holding tank temperatures, were recorded and monitored. TidbiT³ v2 Temp Loggers were used to record temperatures at 30-minute intervals. To collect bottom temperature measurements, a TidbiT was attached to one pot per set string. During each pot string haul, TidbiT loggers were used to measure the holding tank and surface temperatures. Weather conditions were also recorded during hauling and setting.

² Based on Onset data logger website.

³ Product names used in this report are included for scientific completeness but do not constitute product endorsement.

SAMPLING DESIGN

The target marking goal was set at 7,000 sablefish prior to the start of the 2015 survey. Depths ranging from 50 to 500 fathoms⁴ were considered for set placement. Obtaining the tagging goal for a particular statistical area was considered a priority over tagging and marking fish from depths where only a small proportion of the commercial harvest occurred (Table 1-4). To obtain marking goals by depth for each statistical area, bathymetric charts and depth information recorded from the vessel depth sounder from previous years' survey sets were used.

Once the approximate tagging goal was reached for a statistical area, the next statistical area was sampled. If the tagging goal was reached in the middle of a set, sablefish catch in the remaining pots were visually estimated and the fish were released without marking, tagging, or sampling.

To distribute marked/tagged fish throughout a statistical area, no overlapping sets were performed within a statistical area, and sets were performed both over the latitudinal and longitudinal range of a statistical area.

Another consideration to set placement was the history of previous sets for an area. Numbers of sablefish captured, tagged, and marked during previous mark-tag surveys were used to determine placement of sets. Placement of survey gear was avoided in areas where problems had occurred in the past with gear damage or retrieval (Appendix B).

RESULTS

SCHEDULE

The 2015 NSEI mark-tag survey occurred from May 19 to June 12. The survey began in northern Chatham Strait north of the entrance to Icy Strait (Figure 1). The survey progressed south through Chatham Strait with an east-west progression into Frederick Sound. On May 29, the R/V *Medeia* arrived in Petersburg for the end of the first leg of the survey, and the vessel was docked in Petersburg from May 29 to May 31. Bait and supplies were restocked, and the ADF&G scientific staff was transferred. The R/V *Medeia* left the port of Petersburg on May 31 to begin the second leg of the survey. The survey continued south until June 8, reaching the southern end of Baranof Island. The survey then returned north to make several sets before arriving in Juneau on June 12. A detailed list of set location and times can be found in Appendix C.

SET INFORMATION

A total of 1,317 pots were deployed and successfully recovered in 33 sets during the survey. The set depth ranged from 189 to 483 fathoms. Soak time averaged 23.2 hours and ranged from 14.5 to 69.5 hours, and haul time averaged 1.5 hours and ranged from 0.4 to 2.2 hours (Appendix C). Set 17 had a long soak time of 69.5 hours, because it was set prior to travel to Petersburg for the 2-day break in the survey and hauled after this break.

⁴ Fathoms were used in this document instead of metric units for depths because these are the units most commonly used by the commercial fleet and have therefore been the project standard.

CATCH AND TAGGING INFORMATION

A total of 8,613 sablefish were caught during the 2015 survey; 6,862 of these fish were tagged, finclipped, and released. Forty-eight healthy fish were captured and then accidentally released before they could be tagged. An additional 142 sablefish were captured but not marked because of sand flea damage and other injuries, such as pot abrasions or a torn mouth. In addition, an estimated 1,364 sablefish were released without marking because the marking quota had been reached in the statistical area. The catch included 192 sablefish previously tagged by ADF&G that were released with their original tag in place. One fish with a 2012 ADF&G tag was retained because of tissue damage around the tag site. Two fish were captured with Canadian Pacific Bio Station tags and a single fish was captured with a National Marine Fisheries Service (NMFS) tag; all other agency tagged fish were measured and retained. The release condition of all sablefish captured during the 2015 mark-tag survey is summarized by set in Appendix D.

The 2015 mark-tag survey was close to reaching the overall tagging goal of 7,000 sablefish. The number of marked fish approximated the marking goal by statistical area with the exception of Frederick Sound (statistical area 335701), where it is often difficult to meet the marking goal in the allotted time (Table 3). Marked fish were generally distributed throughout statistical areas and in proportions to the depths at which sablefish were caught in the commercial harvest (Table 1; Table 2; Table 4). However, there were a few statistical areas where it was not possible to completely distribute marks in proportion to the 2012–2014 commercial fishery harvest by depth (Table 1; Table 2; Table 4). In statistical areas where the overall marking goal was low and only a few survey sets contributed to the statistical area, it was particularly difficult to approximate marking proportions by depth class. In addition, it was difficult to meet marking goals by depth due to the limitations in predicting depth before a pot string was in the water. Even though the number of fish marked by depth was not always entirely proportional to the fishery harvest by depth for a statistical area, the total number of fish marked for each depth class was similar to the total marking goal for that depth class with a difference of $\leq 4\%$ (Table 2 and Table 4). In addition, all fish marked in Chatham Strait were captured from depths deeper than 250 fathoms, a depth range which accounted for 98% of the 2012–2014 commercial harvest for Chatham Strait; conversely, the majority of marked fish captured in Frederick Sound were from depths shallower than 250 fathoms, a depth range which accounted for 82% of the 2012–2014 commercial harvest for Frederick Sound.

A total of ten species of fish, two species of commercially important crab, and one cephalopod were caught and identified during the 2015 survey (Appendix E). Sablefish was the dominant species caught, followed by arrowtooth flounder (*Atheresthes stomias*), Pacific halibut (*Hippoglossus stenolepis*), Dover sole (*Microstomus pacificus*), and shortspine thornyhead rockfish (*Sebastolobus alascanus*; Appendix E). Two fish were not identifiable due to sand flea damage. A total of 487 Pacific halibut were captured; of these, 340 were released in good condition, 105 were dead (due to sand flea damage), and 42 were dead for unknown reasons. A total of 15 golden king crab (*Lithodes aequispinus*) and three Tanner crab (*Chionoecetes bairdi*) were captured (Appendix E).

BIOLOGICAL INFORMATION

A total of 6,862 sablefish were marked and measured, and an additional 329 sablefish were measured, but not marked. Average length for all measured sablefish was 659 mm (± 87 mm; $n = 7,191$), and length ranged from 390 to 1,070 mm (Figure 3). The 2015 length distribution for

captured sablefish is generally normally distributed with a slight trailing tail at larger lengths and a small peak at small lengths from 480 to 500 mm (Figure 3).

In 2015, small-sized sablefish (≤ 650 mm) composed the majority of the catch (51%). However, the contribution of small-sized sablefish to the catch decreased slightly from the last two years surveys (54% in 2012 and 59% in 2013). Mid- to large-sized sablefish (≥ 660 mm) composed a greater proportion of the overall catch in Frederick Sound (335701) and lower Chatham Strait (345603 and 345631; Table 5). Although a higher proportion of mid- to large-sized fish (≥ 660 mm) were caught in statistical areas in lower Chatham Strait, a few sets had noticeably larger proportions of small-sized fish caught (≤ 650 mm; Figure 4; Table 5).

TEMPERATURE DATA

Sablefish were exposed to a range of temperatures as they were moved from the bottom of the ocean to the surface and then into the holding tank. Sablefish generally appeared healthy and unaffected by these changes in temperature exposure. Bottom temperatures varied less than 1.5 °C throughout the entire survey, with an average bottom temperature by set of 5.0 °C (± 0.3 °C; $n = 33$). Surface temperature ranged from 7.2 °C to 12.4 °C with an average temperature of 9.4 °C (± 0.9 °C; $n=111$). Holding tank temperature ranged from 8.2 °C to 15.5 °C with an average temperature of 10.2 °C (± 1.2 °C; $n = 143$). Sablefish were exposed to a range of temperatures during capture, tagging, and release. There was about 4.4 °C difference between the average surface and bottom temperatures, and 5.2 °C difference between the average holding tank and bottom temperatures. Over the course of a day, the surface and holding tank temperatures varied up to 12.4 °C and 15.5 °C, respectively. Temperature of the holding tank was generally warmer than the surface temperature recorded during a day.

DISCUSSION

The 2015 mark-tag survey was successful with 6,862 sablefish marked in proportion to the commercial fishery harvest by statistical area and depth. The total number of sablefish marked was 98% of the 2015 tagging objective of 7,000 fish. The only statistical area where the tagging goal was not achieved was located in Frederick Sound (statistical area 335701), where it is challenging to meet the marking goal in the allotted time. In 2009 and 2010 the tagging goals were met for the Frederick Sound statistical area of 345702; however, it took six sets each year to catch fewer than 300 sablefish. In comparison, catches in Chatham Strait averaged 280 sablefish per set in 2009 and 266 sablefish per set in 2010. Typically only a small proportion of the fishery harvest occurs in Frederick Sound, with one of the two statistical areas not meeting the minimum 2% of the harvest, the criteria for tagging in a statistical area. However, we continue to tag in Frederick Sound, because this area is geographically far from other areas of Chatham Strait and tagging data shows that fish move freely between Chatham Strait and Frederick Sound. Moreover, some fishermen consistently fish this area due to its proximity to the port of Petersburg and the shallower depths in Frederick Sound that allow fishermen to catch both their halibut and sablefish quotas during one fishing trip, saving both time and money.

Overall an increase in the average length of sablefish caught on the mark-tag survey in recent years supports the idea that sablefish recruitment in Southeast Alaska has been low as observed in the Gulf of Alaska (Hanselman et al. 2015). Surveys may be good indicators of recruitment trends in sablefish fisheries in Southeast Alaska. Fishermen often discard small fish for larger, higher-valued fish; consequently, recruitment patterns are more easily observed in department

longline and pot surveys. Recruitment of sablefish to NSEI was low from 2000 to 2009 as indicated by a steady increase in the average length of sablefish caught during the mark-tag and longline surveys (Figure 5). Since 2009, the average length has stabilized with some recruitment pulses, such as in 2010 and in 2012 (Baldwin and Stahl 2014). In 2015, another small pulse of recruitment was observed with a greater proportion of small-sized sablefish (<510 mm lengths) in the mark-tag survey and SSEI and NSEI longline surveys (Figure 3; Figure 6; Figure 7). Although some recruitment has occurred, it has remained low. In particular, the 2008 year class was not as large as expected when first observed across Southeast Alaska and in the Gulf of Alaska (GOA) in 2010 and 2011 (Hanselman et al. 2013; Stahl et al. 2014); it had been projected to make up 8% of the spawning biomass by 2014 with about 40% of fish mature (Hanselman et al. 2013). However, by 2015, the 2008 year class was only average in biomass, accounting for 10% of the 2015 GOA spawning biomass with about 60% of the fish mature (Hanselman et al. 2014).

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TABLES AND FIGURES

Table 1.—Average proportion of 2012–2014 NSEI sablefish harvest by statistical area and by depth class for each statistical area.

Statistical area	All depth ranges	Depth range (fathoms)								
		30-100	101-150	151-200	201-250	251-300	301-350	351-400	401-450	451-500
335701	4%	4%	5%	13%	60%	18%	0%	0%	0%	0%
345603	11%	0%	0%	1%	4%	16%	28%	50%	0%	0%
345631	30%	0%	0%	0%	0%	1%	31%	68%	0%	0%
345701	35%	0%	0%	1%	1%	6%	44%	26%	12%	9%
345731	12%	1%	0%	0%	2%	33%	57%	8%	0%	0%
345803	8%	0%	0%	0%	7%	22%	50%	21%	0%	0%

Table 2.—Marking goals by NSEI statistical area and depth based on a total goal of 7,000 sablefish.

Statistical area	All depth ranges	Depth range (fathoms)								
		30-100	101-150	151-200	201-250	251-300	301-350	351-400	401-450	451-500
335701	289	11	15	37	174	52	0	0	0	0
345603	788	0	0	11	30	129	224	394	0	0
345631	2067	0	0	0	0	16	636	1,415	0	0
345701	2432	0	0	21	35	153	1,070	635	296	221
345731	841	4	0	0	18	278	477	64	0	0
345803	584	0	0	1	39	128	290	125	0	0
All areas	7,000	15	16	70	297	756	2,697	2,633	296	221
Percent of total	100%	0%	0%	1%	4%	11%	39%	38%	4%	3%

Table 3.—Marking goals and actual number of tagged and marked sablefish released by statistical area for the NSEI mark-tag survey, 2015.

Statistical area	Average percentage of 2012–2014 NSEI commercial harvest	Goal based on 7,000 marks and tags	Proportion marked and tagged	Number marked and tagged
335701	4%	289	1%	71
345603	11%	788	12%	807
345631	30%	2,067	30%	2,064
345701	35%	2,432	36%	2,444
345731	12%	841	12%	856
345803	8%	584	9%	620
Total		7,000		6,862

Table 4.—Number of sablefish marked and tagged by NSEI statistical area and depth class for a total goal of 7,000 sablefish.

Statistical area	Number of fish tagged/marked by depth class (fathoms)							Total
	151–200	201–250	251–300	301–350	351–400	401–450	451–500	
335701	7	40	24	0	0	0	0	71
345603	0	0	160	251	396	0	0	807
345631	0	0	0	636	1,428	0	0	2,064
345701	0	16	72	1,590	709	256	70	2,713
345731	0	40	349	198	0	0	0	587
345803	0	59	109	300	152	0	0	620
All areas	7	155	714	2,975	2,685	256	70	6,862
Percent of total	0%	2%	10%	43%	39%	4%	1%	100%

Table 5.—Number and proportion of sablefish captured and measured by length class (mm) in each statistical area for the NSEI mark-tag survey, 2015.

Statistical area	Number 390–650 mm	Number 660–1070 mm	Proportion 390–650 mm	Proportion 660–1070 mm
335701	23	52	0.31	0.69
345603	371	477	0.44	0.56
345631	956	1,230	0.44	0.56
345701	1,489	1,068	0.58	0.42
345731	516	371	0.58	0.42
345803	323	315	0.51	0.49
Total	3,678	3,513	0.51	0.49

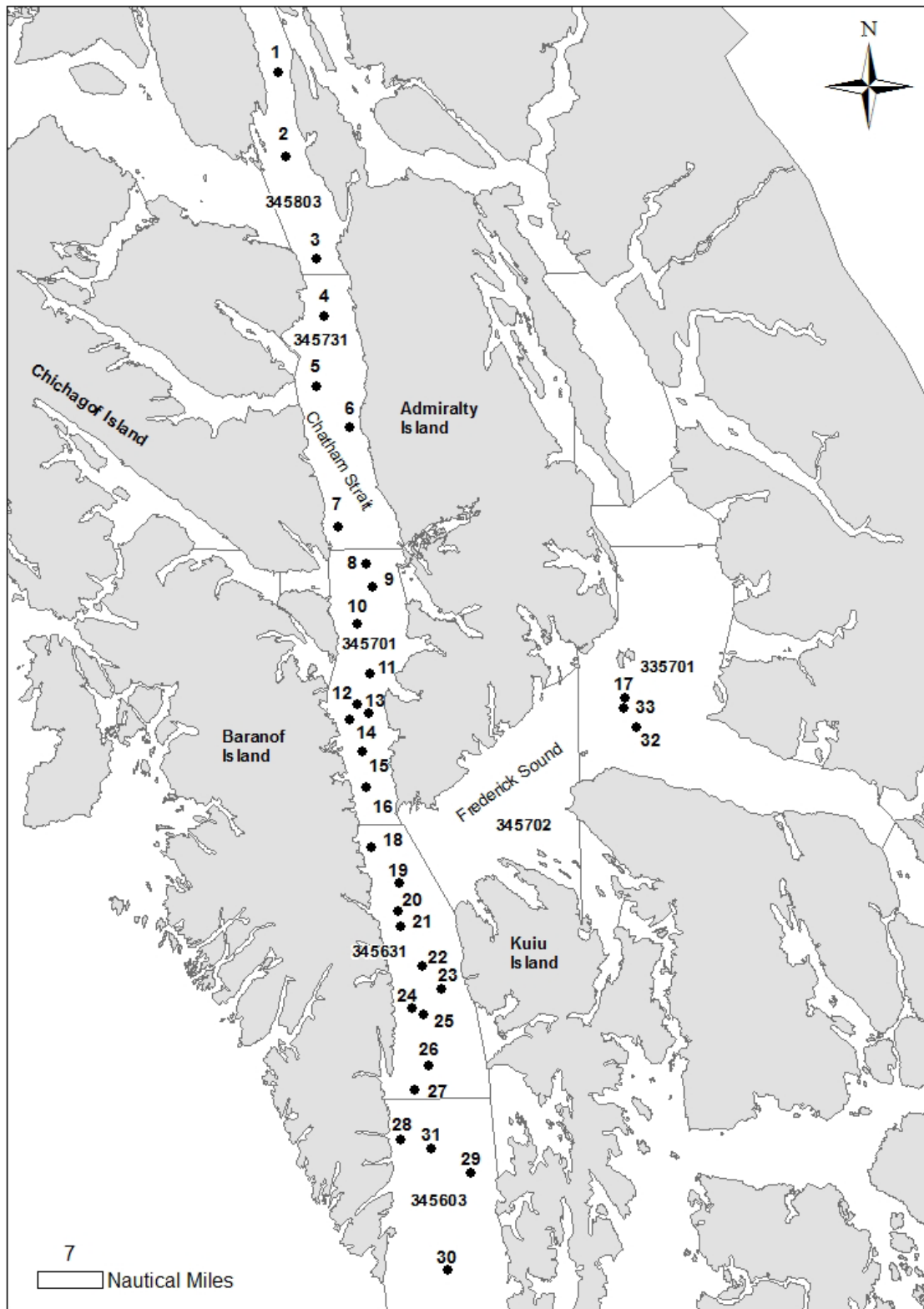


Figure 1.—2015 groundfish statistical management areas and set locations for the NSEI mark-tag survey.

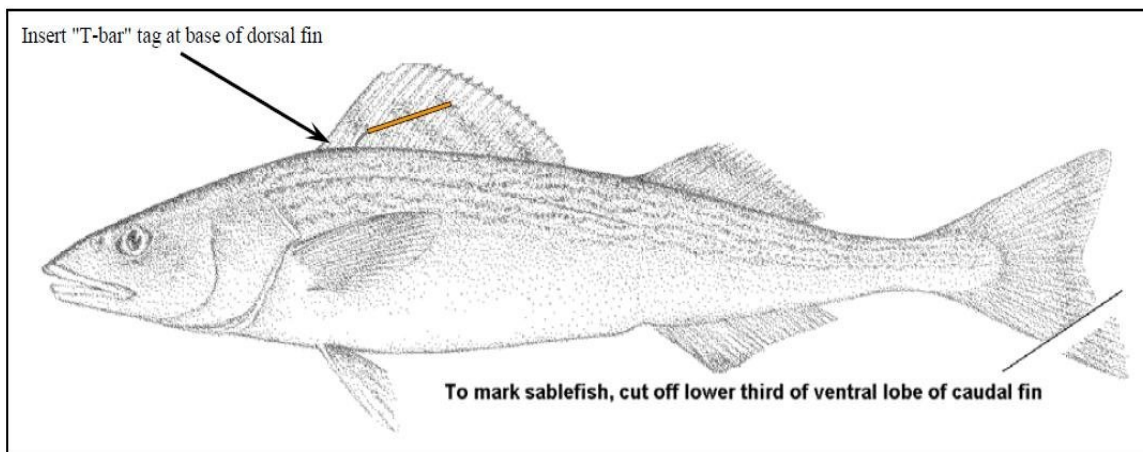


Figure 2.—Sablefish marking guidelines, NSEI mark-tag survey, 2015. Sablefish were double-marked with a lower caudal finclip and a T-bar tag.

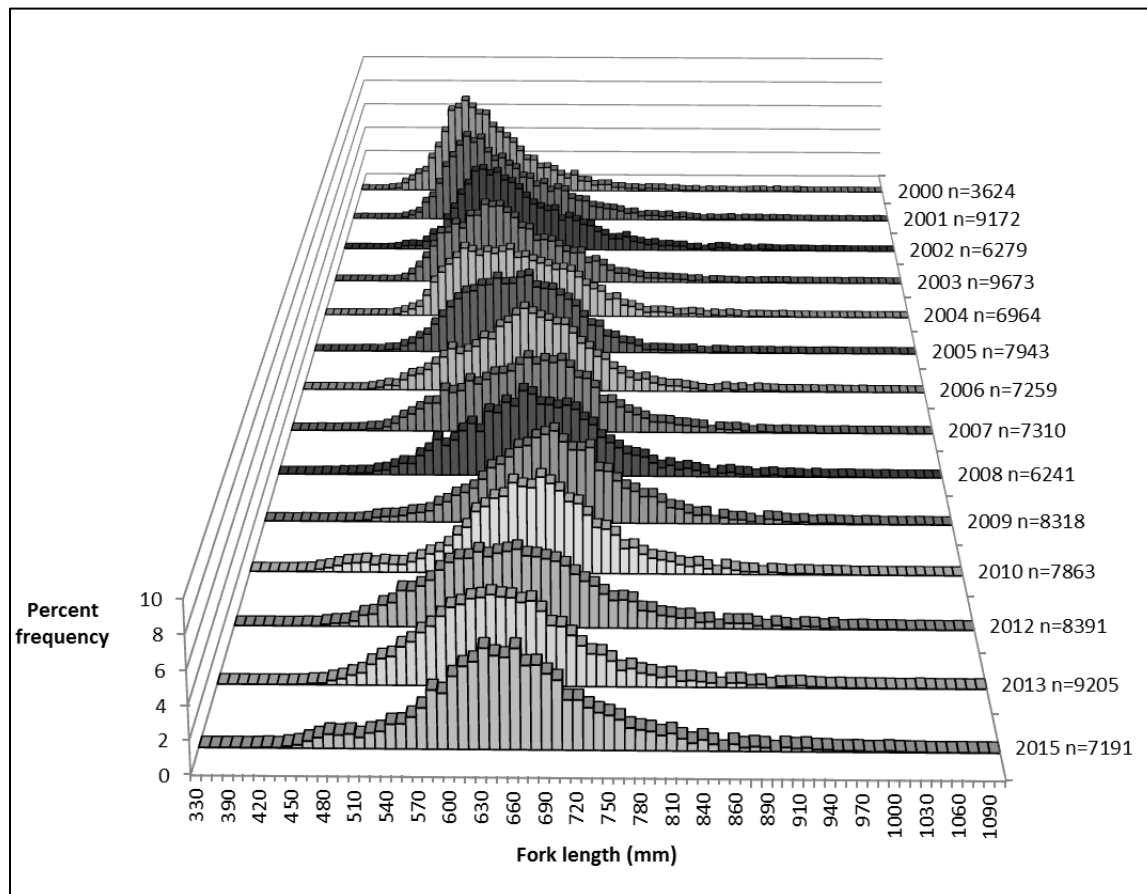


Figure 3.—Length frequency of sablefish captured and measured during the 2000 to 2015 NSEI mark-tag surveys. Surveys did not occur in 2011 and 2014.

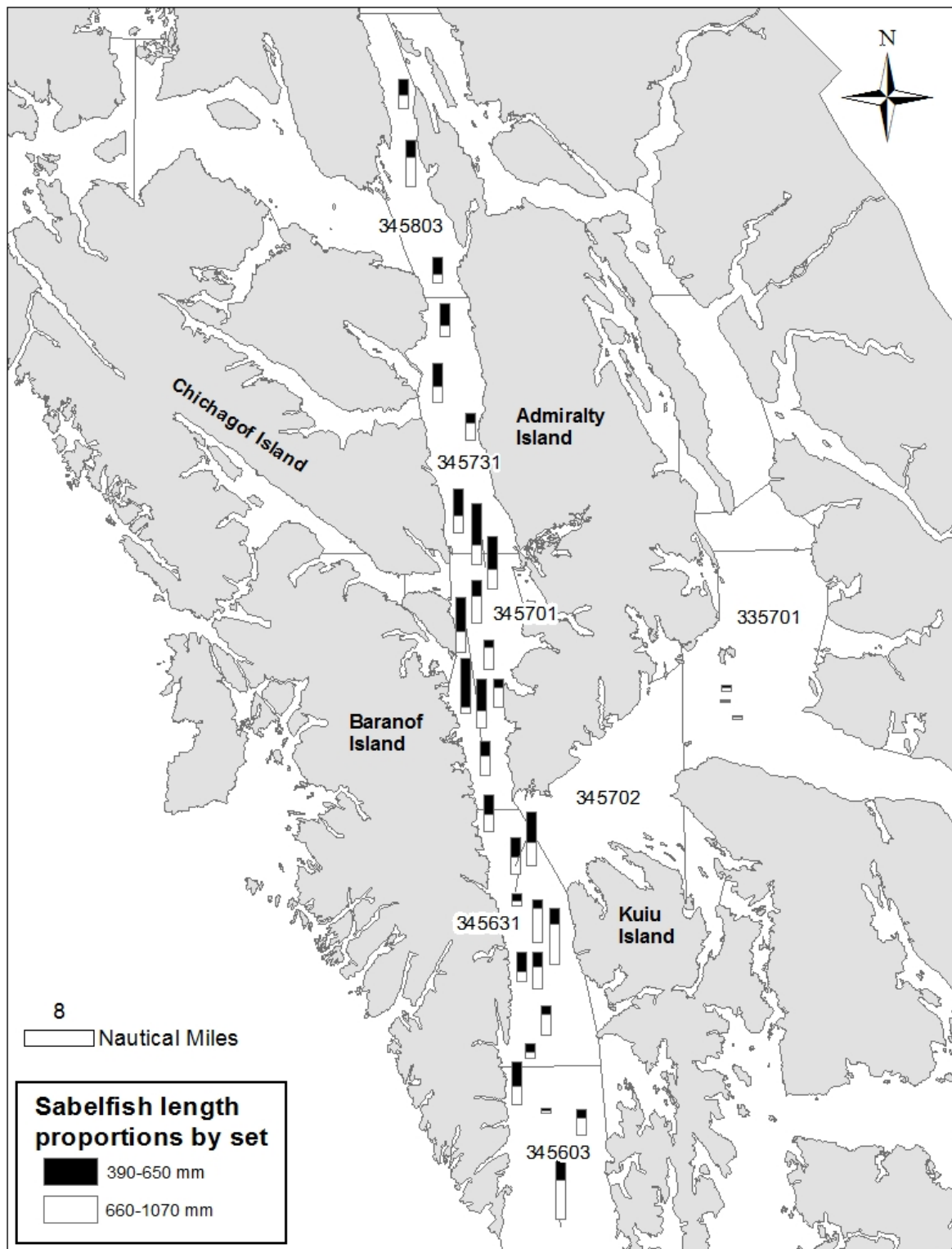


Figure 4.—2015 NSEI mark-tag survey sablefish length distribution by set.

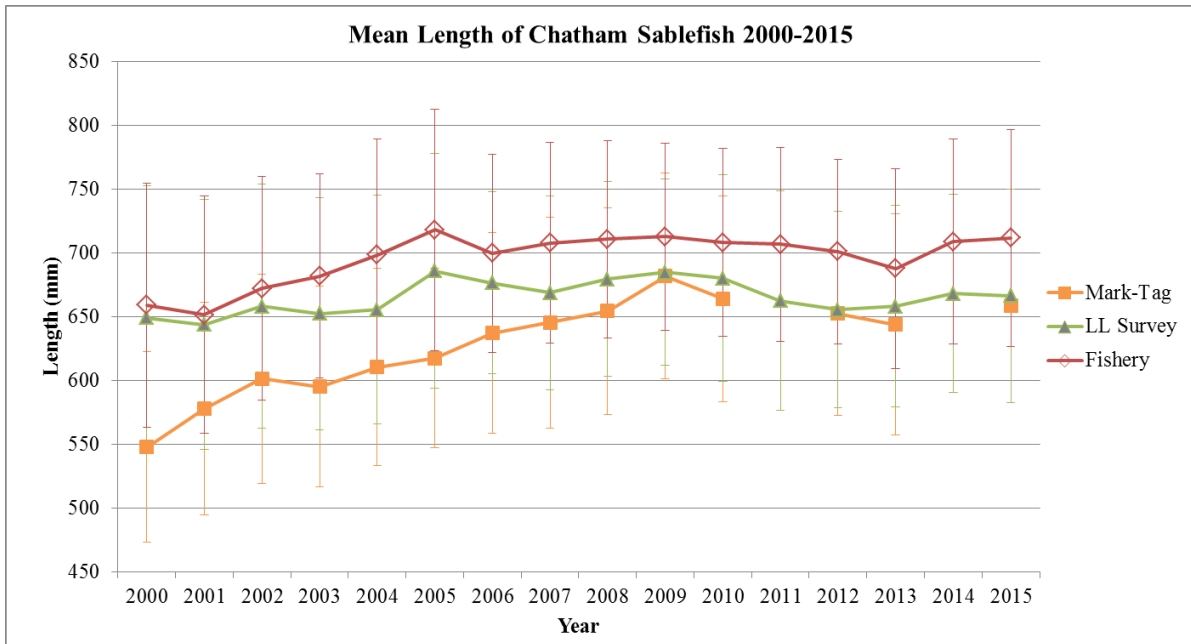


Figure 5.—Average size of sablefish sampled in NSEI Subdistrict from 2000 to 2015. Mark-tag surveys did not occur in 2011 or 2014.

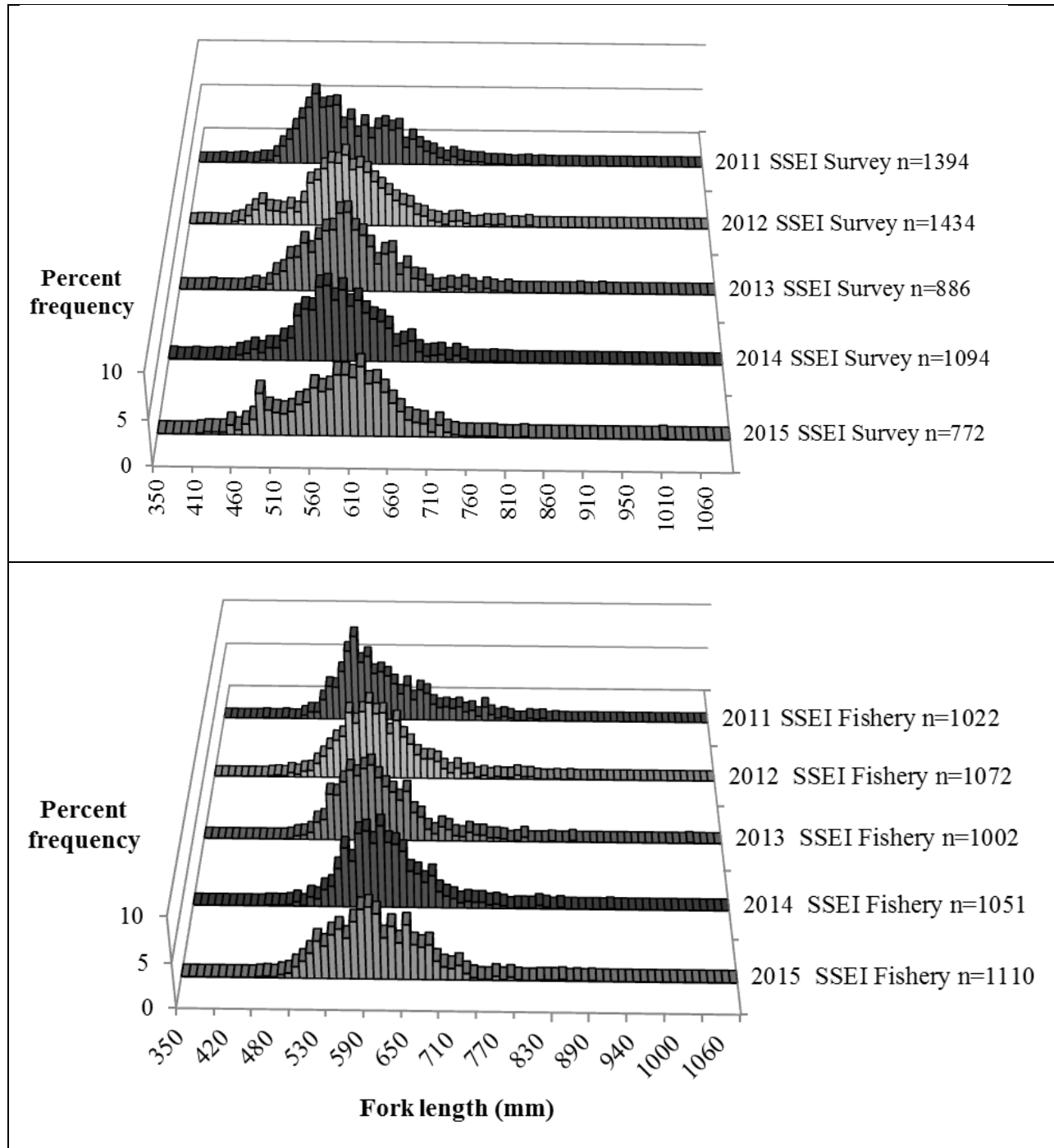


Figure 6.—Length frequency of sablefish sampled during the 2011 to 2015 SSEEI longline surveys (top) and commercial fisheries (bottom).

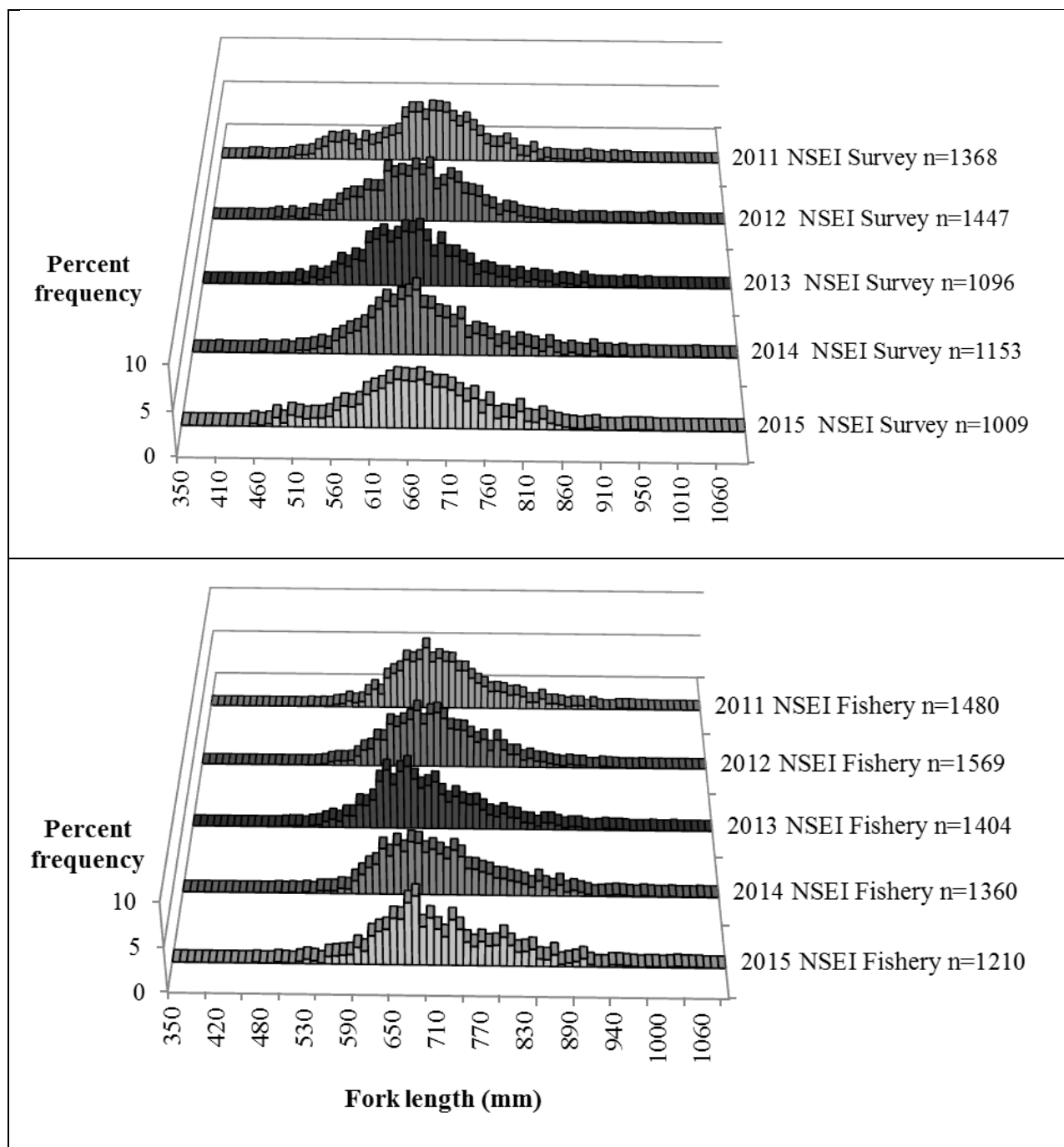


Figure 7.—Length frequency of sablefish sampled during the 2011 to 2015 NSEI longline surveys (top) and commercial fisheries (bottom).

APPENDICES

Appendix A.—The Alaska Department of Fish and Game scientific and vessel staff on the NSEI mark-tag survey, 2015 (first leg, May 19–29; second leg, May 31–June 12).

Name	Position	Leg(s)
Jim deLaBruere	Vessel (Skipper)	1 & 2
Craig Conger	Vessel	1 & 2
Cedar Stark	Vessel	1 & 2
Rick Gottwald	Vessel	1 & 2
Becky Wilson	Vessel	1 & 2
Chris Siddon	Vessel	1
Adam Messmer	Vessel	2
Aaron Baldwin	Survey Leader	1
Jennifer Stahl	Survey Leader	2
Scott Kelley	Scientific Staff	1
Lowell Fair	Scientific Staff	1
Ben Williams	Scientific Staff	1
Asia Beder	Scientific Staff	2
April Roberts	Scientific Staff	2

Appendix B.—Set location issues from the 2012 and 2013 NSEI mark-tag surveys, ordered by set number.

Stat area	Year	Set #	Start				End				Problem
			Lat deg	Lat min	Long deg	Long min	Lat deg	Lat min	Long deg	Long min	
345803	2013	3	58	1.82	-134	52.55	57	59.83	-134	52.09	South end of set becomes shallower; set slightly to the east
345731	2013	6	57	32.34	-134	45.81	57	30.55	-134	43.49	Set is near reef; follow exact track to avoid
345701	2012	7	57	29.47	-134	47.10	57	27.68	-134	46.74	Hard substrate and barnacles caused line break-avoid area
345701	2012	9	57	23.01	-134	42.63	57	21.42	-134	42.77	Line caught on bottom, possibly due to hard substrate
345701	2013	9	57	23.20	-134	42.72	57	21.78	-134	44.47	Avoid shallow hard bottom at south end; best hauled south to north
345701	2012	11	57	13.06	-134	41.44	57	11.56	-134	41.34	Line caught on bottom, possibly due to hard substrate
345631	2013	22	56	44.44	-134	31.54	56	42.78	-134	31.87	Hard bottom, derelict crab gear on bottom
345631	2013	23	56	39.42	-134	28.90	56	41.36	-134	28.12	Hard bottom; do not go south of set, set south to north
345603	2012	27	56	27.08	-134	36.21	56	28.95	-134	35.84	North end of set hard bottom high rockfish numbers
345603	2013	28	56	21.97	-134	22.54	56	20.19	-134	22.38	Hard bottom, rising at north ends
345603	2013	30	56	22.97	-134	28.70	56	24.54	-134	30.23	Relief on north end, catches better in north

Appendix C.—Detailed set information, including location and timing, for the NSEI mark-tag survey, 2015.

Set	Stat area	Start				End				Date Set	Time set	Soak time (h)	Haul time (h)	Haul direction	# Pots set	Depth (fathoms)			
		Lat deg	Lat min	Long deg	Long min	Lat deg	Lat min	Long deg	Long min							Start	End	Avg	Substrate
1	345803	58	22.08	-135	0.29	58	19.99	135	0.39	5/19/2015	1612	15.2	2.14	Opposite	39	332	253	291	Unknown
2	345803	58	12.87	-134	58.68	58	14.86	134	59.52	5/19/2015	1351	21.8	2.18	Opposite	40	377	335	357	Mud
3	345803	58	1.74	-134	52.60	57	59.94	134	52.46	5/20/2015	1639	15.6	2.0	Opposite	40	341	316	323	Unknown
4	345731	57	55.45	-134	51.07	57	53.57	134	50.76	5/20/2015	1805	17.2	1.38	Same	40	241	273	260	Mud
5	345731	57	47.70	-134	52.62	57	45.77	134	52.28	5/21/2015	1631	15.1	1.38	Opposite	40	282	303	295	Mud
6	345731	57	43.31	-134	45.67	57	41.59	134	46.37	5/21/2015	1752	16.5	1.27	Opposite	40	299	313	304	Unknown
7	345701	57	32.47	-134	48.20	57	34.02	134	46.49	5/22/2015	1534	16.4	1.40	Same	40	346	308	324	Mud
8	345701	57	28.43	-134	42.46	57	26.61	134	43.44	5/22/2015	1739	19.1	1.56	Same	40	300	315	317	Mud
9	345701	57	25.90	-134	41.15	57	24.04	134	41.99	5/23/2015	1143	22.0	2.14	Opposite	40	292	305	302	Mud
10	345701	57	21.89	-134	44.38	57	23.48	134	42.46	5/23/2015	1657	20.1	1.45	Same	40	296	317	314	Mud/Hard
11	345701	57	16.43	-134	41.78	57	14.79	134	42.23	5/24/2015	1626	14.5	1.35	Opposite	39	416	483	445	Unknown
12	345701	57	13.01	-134	44.43	57	11.37	134	43.50	5/24/2015	1735	17.5	2.7	Opposite	40	381	365	368	Mud
13	345701	57	12.06	-134	42.14	57	10.08	134	42.21	5/25/2015	1039	21.6	1.38	Opposite	40	446	394	429	Mud/Hard
14	345701	57	11.34	-134	45.90	57	9.72	134	45.38	5/26/2015	750	23.3	1.48	Same	39	327	336	332	Unknown
15	345701	57	7.97	-134	43.36	58	6.11	134	42.27	5/26/2015	1215	43.2	1.47	Opposite	40	351	355	350	Mud
16	345701	57	4.03	-134	42.77	57	2.11	134	42.40	5/27/2015	1055	24.0	1.44	Opposite	40	355	355	359	Mud
17	335701	57	13.41	-133	50.62	57	14.84	133	49.01	5/29/2015	955	69.5	1.32	Opposite	40	266	202	229	Mud
18	345631	56	57.46	-134	41.80	56	55.32	134	41.51	6/1/2015	1630	15.4	1.52	Opposite	40	338	333	339	Mud
19	345631	56	53.48	-134	36.24	56	51.76	134	35.02	6/1/2015	1355	23.2	2.2	Same	40	365	379	373	Mud
20	345631	56	50.44	-134	36.38	56	51.77	134	38.73	6/2/2015	1216	21.2	2.4	Same	40	386	367	378	Mud
21	345631	56	48.81	-134	35.98	56	46.83	134	35.03	6/2/2015	1729	21.3	1.54	Same	40	395	396	396	Unknown
22	345631	56	44.49	-134	31.59	56	42.58	134	31.87	6/3/2015	1806	15.5	2.14	Same	40	365	398	388	Hard
23	345631	56	41.94	-134	27.93	56	40.01	134	28.63	6/3/2015	1956	19.5	2.16	Same	40	348	347	343	Coral
24	345631	56	39.92	-134	33.79	56	41.94	134	33.87	6/4/2015	1332	21.4	1.53	Opposite	40	365	378	372	Mud/Gravel
25	345631	56	39.11	-134	31.61	56	37.30	134	33.21	6/4/2015	1927	20.5	1.43	Same	40	375	356	366	Mud
26	345631	56	33.58	-134	30.47	56	35.67	134	29.78	6/5/2015	1445	20.3	1.46	Opposite	40	358	355	356	Hard

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Set	Stat area	Start				End				Date Set	Time set			Haul direction	# Pots Set	Depth (fathoms)			
		Lat deg	Lat min	Long deg	Long min	Lat deg	Lat Min	Long deg	Long min			Soak time (h)	Haul time (h)			Start	End	Avg	Substrate
27	345631	56	30.92	-134	33.39	56	27.69	134	36.17	6/5/2015	1930	21.5	1.37	Opposite	40	332	302	319	Mud
28	345603	56	25.55	-134	36.20	56	27.69	134	36.17	6/6/2015	1447	20.4	1.47	Opposite	40	303	322	313	Mud
29	345603	56	21.88	-134	22.55	56	19.71	134	22.38	6/7/2015	804	22.3	1.34	Same	40	265	256	267	Hard
30	345603	56	11.25	-134	27.22	56	13.23	134	27.23	6/7/2015	1642	18.6	1.54	Same	40	355	385	371	Rock
31	345603	56	24.53	-134	30.22	56	22.56	134	28.51	6/8/2015	1002	21.2	1.46	Opposite	40	384	399	394	Unknown
32	335701	57	10.26	-133	48.21	57	12.15	133	48.17	6/9/2015	1616	19.4	0.38	Same	40	189	233	210	Mud
33	335701	57	12.27	-133	50.78	57	10.53	133	52.38	6/9/2015	1010	47.2	1.31	Same	40	257	203	236	Mud/Gravel

Appendix D.—Numbers of sablefish marked, released, retained, or discarded by set for the NSEI mark-tag survey, 2015. Lost sablefish were those that escaped overboard before sampling or marking occurred.

Set	Released		Retained				Discarded					Total
	Tagged and marked	Previously tagged by ADF&G	Previously tagged by ADF&G	Mortality	Retained	Previously tagged by other agency	Sand fleas	Not marketable (due to injuries)	Numbers estimated due to reach quota	Lost		
1	183	1	-	-	-	-	-	2	61	2	244	
2	285	2	-	-	-	-	5	1	-	-	293	
3	152	2	-	-	-	-	1	5	70	-	230	
4	202	-	1	-	-	-	-	-	-	-	203	
5	237	1	-	-	1	-	-	5	90	1	335	
6	148	13	-	-	-	-	5	1	-	3	170	
7	269	4	-	-	-	-	-	1	58	4	336	
8	355	17	-	-	-	-	-	12	97	3	484	
9	313	11	-	2	-	-	-	6	193	2	527	
10	260	6	-	-	-	-	1	2	-	5	274	
11	188	1	-	-	-	-	-	6	-	3	198	
12	325	17	-	-	-	-	-	2	-	3	347	
13	163	7	-	-	-	-	-	2	-	3	175	
14	335	5	-	-	-	-	3	5	-	1	349	
15	292	8	-	-	-	-	-	7	-	1	308	
16	213	3	-	-	-	-	-	2	202	1	421	
17	38	1	-	-	-	-	-	1	-	2	42	
18	221	8	-	-	-	-	-	2	-	2	233	

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Appendix D.—Page 2 of 2.

Set	Released		Retained				Discarded					Total
	Tagged and marked	Previously tagged by ADF&G	Previously tagged by ADF&G	Mortality	Retained	Previously tagged by other agency	Sand fleas	Not marketable (due to injuries)	Numbers estimated due to reach quota	Lost		
19	310	10	-	-	-	2	-	14	-	10	346	
20	225	2	-	2	-	1	-	5	-	-	235	
21	72	1	-	-	-	-	-	2	-	-	75	
22	254	10	-	-	-	-	-	7	-	-	271	
23	323	16	-	-	-	-	-	8	-	1	348	
24	175	3	-	1	-	-	-	5	-	-	184	
25	217	7	-	-	-	-	-	1	-	-	225	
26	175	8	-	-	-	-	-	4	35	-	222	
27	92	3	-	-	-	-	-	1	151	-	247	
28	251	10	-	-	-	-	-	3	20	-	284	
29	160	4	-	-	-	-	-	-	83	1	248	
30	373	9	-	-	-	-	-	12	-	-	394	
31	23	2	-	-	-	-	-	1	304	-	330	
32	22	-	-	-	-	-	-	-	-	-	22	
33	11	-	-	-	-	-	-	2	-	-	13	
Total	6,862	192	1	5	1	3	15	127	1,364	48	,613	

Appendix E.—2015 NSEI mark-tag survey bycatch captured by set.

Set	Groundfish					Sharks	Rockfish				Crabs		Other	Total
	Pacific cod	Arrow- tooth flounder	Pacific halibut	Dover sole	Unknown general groundfish	Pacific sleepers shark	Shortspine thorny- head	Rough- eye	Short- raker	Dusky	Tanner crab	Golden king crab	Octopus	
1	-	2	9	-	-	-	-	-	-	-	-	-	-	11
2	-	1	2	1	2	-	-	-	-	-	-	-	-	6
3	-	10	7	1	-	1	-	-	-	-	-	-	-	19
4	-	8	12	-	-	-	-	-	-	-	2	-	-	22
5	-	6	5	-	-	-	-	-	-	-	-	-	-	11
6	-	4	4	1	-	-	-	-	-	-	-	-	-	9
7	-	5	-	-	-	-	-	-	-	-	-	-	-	5
8	-	6	5	2	-	-	-	-	-	-	-	2	-	15
9	-	6	1	1	-	-	-	-	-	-	-	-	-	8
10	-	1	1	1	-	-	2	-	3	-	-	-	-	8
11	-	1	3	4	-	-	5	-	-	-	-	-	-	13
12	-	4	8	6	-	-	2	-	-	-	-	-	-	20
13	-	7	2	6	-	-	-	-	-	-	-	2	-	17
14	-	10	5	3	-	-	-	-	-	-	-	-	-	18
15	-	4	12	3	-	-	-	-	-	-	-	-	1	20
16	-	5	8	3	-	-	1	-	-	-	1	1	-	19
17	6	86	107	2	-	-	2	1	-	-	-	1	-	205
18	-	23	12	7	-	-	1	-	-	-	-	1	-	44
19	-	21	17	5	-	-	-	-	1	-	-	-	-	44
20	-	17	10	4	-	-	3	-	-	-	-	-	-	34

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Set	Groundfish					Sharks	Rockfish				Crabs		Other	Total
	Pacific cod	Arrow- tooth flounder	Pacific halibut	Dover sole	Unknown general groundfish	Pacific sleepers shark	Shortspine thorny- head	Rough- eye	Short- raker	Dusky	Tanner crab	Golden king crab	Octopus	
21	-	8	3	30	-	-	1	-	-	-	-	-	-	42
22	-	4	1	3	-	-		-	-	-	-	1	-	9
23	-	7	1	1	-	-	2	-	-	-	-	-	-	11
24	-	10	6	6	-	-	-	-	-	-	-	-	-	22
25	-	6	2	3	-	-	-	-	-	-	-	1	-	12
26	-	9	5	4	-	-	-	-	-	-	-	1	-	19
27	-	18	9		-	-	1	-	-	-	-		-	28
28	-	11	5	5	-	-	2	-	-	-	-	1	-	24
29	-	9	7		-	-	4	1	-	-	-	-	-	21
30	-	12	6		-	-	1		-	-	-	1	-	20
31	-	15		4	-	-	-		-	-	-	-	-	19
32	2	122	107	2	-	-	1	1	-	-	-	-	-	235
33		86	105		-	-	-	1	-	1		3		196
Total	8	544	487	108	2	1	28	4	4	1	3	15	1	1,206